Appendix C.
Guidelines for Developing Standard Operating Procedures (SOPs) for Fenceline Monitoring

C-1. Introduction

To better assure reliable results associated with a FFMS at a HTRW site, well defined sampling and analytical methods and administrative procedures must be established, reviewed and approved. For operations or procedures that are repetitive, (i.e. each definable feature of work), these procedures are best established through the use of Standard Operating Procedures (SOPs). As defined by the EPA, an SOP "is a written document that provides directions for the step-by-step execution of an operation, analysis, or action that is commonly accepted as routine or repetitive." SOPs can serve as useful tools for assuring that a procedure is applicable for a specific project requirement, for training new personnel and for maintaining consistency of an operation throughout the duration of a project. SOPs must be written with sufficient detail so that someone with general knowledge or experience with a procedure can understand and consistently duplicate it.

This appendix contains information based upon EPA's "Guidance for the Preparation of Standard Operating Procedures (SOPs) for Quality-Related Documents," EPA/600/R-96/027. This guidance was provided by EPA for developing SOPs to promote quality through consistency and is applicable for sampling and analysis at Superfund or HTRW sites.

In addition, this appendix provides an example of an SOP which was written to be applicable to a common element of a FFMS at a HTRW site.

C-2. Reasons for Development

SOPs are developed to define the specific activities that make up a routine operation and the recommended sequence of those activities. SOPs can provide the basis for the development and reference of other SOPs which have similar or inter-related activities. As routine operations are carried out, the steps outlined in the SOP should be followed. An existing SOP can also serve as a mechanism for changing a procedure or establishing new project related procedures. SOPs also enable deviations from a procedure to be defined and recorded.

SOPs also provide criteria which allows someone independent of the activity to effectively perform general over-sight of the activity or a procedural audit.

C-3. SOP Guidelines

SOPs must be prepared to be functional: i.e., clear, comprehensive, up-to-date, and sufficiently detailed to permit duplication of procedures by qualified personnel. SOPs must reflect activities as they are currently performed. In addition, all SOPs must:

- Be in accordance with current applicable regulations, USACE guidelines, and state/local agency requirements.
- Be consistent with instrument manufacturer's specific instruction manuals.
- Identify documentation requirements that are sufficiently complete to accurately record the performance of all tasks (performed by the protocol).
- Require the validity of data reported and explain the cause of missing or inconsistent results.
- Describe the corrective action and feedback mechanism utilized when analytical results do not meet protocol requirements.
- Be reviewed regularly and updated as necessary when contract, facility, or procedural modifications are made.
- Be archived for future reference in usability or evidentiary situations.
- Be available at specific work stations as appropriate.
- Be subject to document control procedures which precludes the use of outdated or inappropriate SOPs.

C-4. SOP Format and Content

The format and content for SOPs may vary depending upon the kind of activity for which they are prepared. The following SOP formats for technical and adminstrative procedures are suggested by EPA/600/R-96/027:

Technical SOP:

- **Title Page** - includes the SOP name, SOP number, signatures of SOP preparer and reviewers, and a SOP Manual Control Number.
- **Scope and Application** - describes the reason(s) for writing the SOP, with its intended use. Applicable target analytes, sample matrices, and detection limits should be included.
- **Summary of Method -** provides a brief summary of the procedure or method.
- **Definitions** - provides acronyms, abbreviations and specialized forms used in the SOP.
- **Health and Safety** - discusses all known and potential problems that may require personnel protective equipment or other special safety precautions.
- **Cautions** - indicates activities that could result in equipment damage, degradation of sample or possible invalidation of results, listed here and at the critical steps in the procedure.

- **Interferences** - addresses all known interferences or potential problems that may be encountered during the method performance or procedure.

- **Personal Qualifications** - includes any special training or experience requirements for the procedure.

- **Equipment/Apparatus** - lists all instruments (manufacturer's names and model numbers), glassware (grade and class) and applicable ancillary equipment needed to perform the method. If appropriate, GC columns are identified.

- **Instrument or Method Calibration -** references calibration method and the applicable SOP.

- **Sample Collection -** describes in detail the method of collection or references the applicable SOP.

- **Sample Preservation, Container, Handling, and Storage** - addresses all conditions necessary to maintain the integrity of the sample. Specifies the sample container type, chemical preservation (if required), amount of sample needed for analysis, storage requirements, and applicable holding times.

- **Sample Preparation and Analysis** - describes the sample preparation and analytical procedure or references the applicable SOP when field analysis is being performed.

- **Trouble Shooting** - describes the trouble spots of the procedure based on previous method experience and the problem identification.

- **Data Acquisition,Calculations & Data Reduction** - provides the equations/formulas for calculating results. Also includes appropriate definitions.

- **Computer Hardware & Software** - (used to manipulate analytical results and report data).

- **Data Management & Records Management** - specifies the data collection, manipulations, reporting and data storage or references the appropriate SOP.

- **Quality Assurance/Quality Control** - specifies the frequency and acceptance criteria for QA/QC samples (e.g., blanks, surrogates, duplicates, spikes, run sequences, etc.). Also lists QA/QC requirements for other QC activities, including equipment calibration, implementation of manufacturers instructions, analyst proficiency demonstration, etc.

- **References** - lists all sources of information used in writing the SOP (i.e., instrument manuals, published methods, QA/QC manuals, other SOPs).

Administrative SOP:

- **Title Page** - includes the SOP name, SOP number, signatures of SOP preparer and reviewers, and a SOP Manual Control Number.

- **Purpose** - describes the reason(s) the SOP is being performed.
- **Applicability** - describes the project and project element to which the administrative SOP applies.
- **Summary of Procedure** - provides a brief summary of the procedure or method.
- **Definitions** - provides acronyms, abbreviations and specialized forms used in the SOP.
- **Personal Qualifications** - includes any special training or experience requirements for the procedure.
- **Procedures** - provides a detailed description of how the procedure is performed.
- **Quality Assurance/Quality Control** - specifies the procedures, frequency of implementation, and acceptance criteria for the administrative review of documents, data collection planning and implementation, data assessment, staff evaluation, etc.
- **References** - lists all sources of information used in writing the SOP (i.e., program plans, project objectives, regulatory QA/QC policy, resource allotment, guidance manuals, published methods, other SOPs etc).

C-5. SOP Control

SOPs are controlled to ensure that procedures are understood and are in the hands of those responsible for performing the activities. Before SOPs and revisions are released, they should be reviewed to ensure that their contents are adequate and accurate and that quality requirements are appropriately stated. Obsolete or superseded SOPs must be controlled through an archival process to prevent inadvertent use. This control may be facilitated through the maintenance of a master list of SOPs that includes the current revision level and publication date of all SOPs. In addition, it is recommended that the revision levels and publication dates be printed in the upper right corner of all pages of each SOP.

C-6. Example of SOP Involving Performance Evaluation Audit for FFMS for Calculating Accuracy and Precision of a Real-Time, On-Line, Analytical System.

SOPs should be established for each component of the FFMS, from sample collection, sample analysis through performance evaluation audits. SOPs should be incorporated into the site Field Sampling Plan (FSP). Typical SOPs for a FFMS at a HTRW site may address the following technical areas:

- SOP for the Operation and Maintenance of the Sample Collection System.
- SOP for the Continuous Operation of the Analytical System in the Analytical Center.
- SOP for the Operation and Maintenance of the Meteorological System.

- SOP for the Operation and Maintenance of the Data Acquisition System.
- SOP for the Performance Evaluation Audits Associated with a FFMS.
- SOP for Evaluation of Precision and Accuracy for Data Collected From a FFMS.

One component of a site FSP may involve periodic audits of the FFMS for documenting data precision and accuracy through the use of Reference Measurement Method (RMM) for NMOC and speciated organics, (i.e. BETX), identical to the site target compound list. The SOP must be established in order to ensure that the audit is executed in a manner to generate valid and accurate data. To illustrate the fact that SOPs do not need to be extensive documents, Figure C-1 illustrates an example SOP developed for a FFMS at a HTRW site entitled: *"Quality Control (QC) Evaluation of a FFMS Sample Collection System Utilizing a Reference Measurement Method (RMM) for Evaluating Accuracy and Precision."*

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Project Name: _____
Project Site: _____

TITLE: Quality Control (QC) Evaluation of a FFMS Sample Collection System Utilizing a Reference Measurement Method (RMM) for Evaluating Accuracy and Precision

SOP NUMBER: _____

PREPARED BY: _____
PREPARATION DATE: _____

REVIEWED BY: _____
Technical Specialist Organization Date

_____
QA Officer Date

Figure C-1. Example SOP for FFMS System Accuracy and Precision Determination.

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1.0 Scope and Application

This Standard Operating Procedure (SOP) provides the method to be used to evaluate a segment of the sample collection system of a FFMS. The SOP is used to evaluate any air sample component loss which may occur in the sample inlet or within the sample transport line.

2.0 Method Summary

A standard reference material is introduced at the perimeter of the site into the sample inlet of the sample collection system and is transported to the Analytical Center by the sample collection system, utilizing the same mechanism and operating parameters as used during the routine perimeter monitoring. A sample is collected in the Analytical Center using a supporting RMM. NMOC and speciated oganics will be quantified at an off-site lab by the use of Compendium Method TO-14. The NMOC and GC speciation will be conducted concurrently at the analytical center to provide an evaluation of the analytical center performance. A minimum of three RMMs are collected during monitor evaluation.

3.0 Definitions

The Fixed-Fenceline Monitoring System (FFMS) includes the analytical, sample collection, data collection and meteorological monitoring components. NMOCs are NonMethane Organic Compounds determined with a Photo Ionization Detector.

4.0 Health and Safety

Hazards which may result from the use of high pressure cylinder gases, pressure gauges, high voltage heat-traced lines or specific gaseous components may occur as a result of performing this procedure.

5.0 Cautions

The pressurized cylinder gas may damage the sample inlet, or analytical center if not properly regulated. The components and balance gas in the cylinder must be compatible with the analytical center instrumentation and the receiving canister

6.0 Interferences and Potential Problems

The most likely method errors occur from leaky connections, contamination entering the collection lines during disturbance of the sample inlet and contaminated RMM canisters.

Figure C-1. (Continued).

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7.0 Personal Qualifications

Only personnel that are experienced/trained in the operation of gas cylinders/regulators and trained to collect TO-14 canister samples should perform this SOP

8.0 Reagents

A standard reference gas cylinder containing the project target analyte list compounds of interest in a humidified air balance gas. The gas cylinder should be certified as either:

- NIST--Standard Reference Materials (SRMs).
- Gas Manufacturers Primary Standard (GMPS).
- Gas Manufacturers Certified Reference Materials (CRMs)

9.0 Procedure

9.1 The initial step of this procedure is to notify/confirm with relevant site project personnel that the regular sampling schedule will be disrupted and that an alarm situation will be overridden or be exempt from project required corrective actions.

9.2 The RMM is connected to the field sample Analytical Center inlet by the use of a “Tee” connection such that the real-time analytical system remains operational. The canister inlet must be Tee’d such that a pump can be used to purge the connecting line with the introduced reference gas prior to canister sampling initiation.

9.3 The cylinder pressure regulators are attached to the standard reference cylinder and connected to the inlet of the sample point at the perimeter of the HTRW site. All connections must be adequate to prevent leaks. With the FFMS sample collection pump in operation, provide sufficient standard reference cylinder gas flow that the same sample flow that is used for routine sampling is achieved with no in-leakage of ambient air. The temperature at the sample inlet must be measured to within 1 °C and recorded.

9.4 After a time greater than the collection system response time, check the analytical monitor for operation and then begin the canister sampling line purge pump. Verify that the analytical system is in operation and confirm that the monitor has been calibrated and complies with calibration requirements. After a minimum of nine minutes of line purging, initiate the canister sample collection in the Analytical Center. To evaluate the analytical system in the Analytical Center, be certain the sample is collected over a time-collection-interval such that three or more analytical system results are obtained. The temperature of the Analytical Center must be measured to within 1 °C and recorded. Record the temperature of the FFMS collection line to within 1 °C if heated.

Figure C-1. (Continued).

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The following checklist should be used to verify appropriate operation and documentation prior to and during sampling activities:

- Does the field data include the site identification, time and date, personnel involved, etc?
- Has the standard reference gas cylinder serial number and gas composition been recorded in the log book?
- Is a sufficient amount of cylinder gas flowing that no in-leakage or a negative pressure within the sampling line is generated?
- Is the RMM using the canister sample collection rate sufficiently low to coincide with three successive analytical center results?
- Can the sampling conditions be maintained such that two or more canister samples can be collected?
- Are the sampling start and finish times for the canister samples marked clearly on the strip chart?
- Is the canister sample collected at a constant rate?
- Is the analytical system in the Analytical Center operating according to established SOP criteria?

9.5 At the completion of the first collection system evaluation, perform the same procedure on any additional specified segments of the system.

10.0 Data Calculations and Validation

10.1 For calculating percent relative differences (PRD) for sample collection and transfer efficiency, use the following equation:

$$PRD = \frac{X_1 - X_2}{\overline{X}} \times 100\%$$

where:

X_1 = The measured value as documented by the real-time, on-line, analytical system in the Analytical Center.

X_2 = The measured value as documented by the manufacturer's certificate for that standard reference gas cylinder.

$\overline{X}$ = The means of the duplicate values $[(X_1 + X_2)/2]$.

10.2 For analytical system accuracy (%A):

$$\%A = \frac{X_1}{X_2} \times 100\%$$

Figure C-1. (Continued).

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where:

X_2 = The reference method monitoring (RMM) result.

$\overline{X_1}$ = The average Analytical Center result.

11.0 Quality Assurance/Quality Control

The QC required for this procedure includes a canister trip blank, Analytical Center calibration and performance verification requirements, etc.

12.0 References

13.1 US Army Corps of Engineers, Requirements for the Preparation of Sampling and Analysis Plans, EM 200-1-3.

13.1 EPA Compendium Methods for the Determination of Toxic Organic Compounds in Ambient Air . EPA 625/R-96/060A

Figure C-1. (Continued).